A Strategy for Improving Interoperability Of Weapons Systems Electronics

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by

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Agenda

1. Statement of Problem and Approach
2. Overview of Methodology
3. Status of Pilot Tests
4. Observations

Definition

We define interoperability of weapons systems electronics as the:

- Interchangeable use of hardware and software across many kinds of weapons and commercial systems
- Ability of weapons systems electronics to interoperate effectively in joint operations

What is the problem we are addressing?

- DoD's National Defense goal is to sustain superior warfighting effectiveness as efficiently as possible,

- But currently, our weapons systems:
  - Have problems interoperating with each other and with C4I systems
  - Have Unique implementations of similar functionality leading to
    - Much duplication of effort
    - Problems with reliability, maintainability and availability
  - Costly: closed designs lead to sole source products
    - Minimal use of COTS products
    - Lack of competitiveness to reduce cost
    - Increased logistics costs

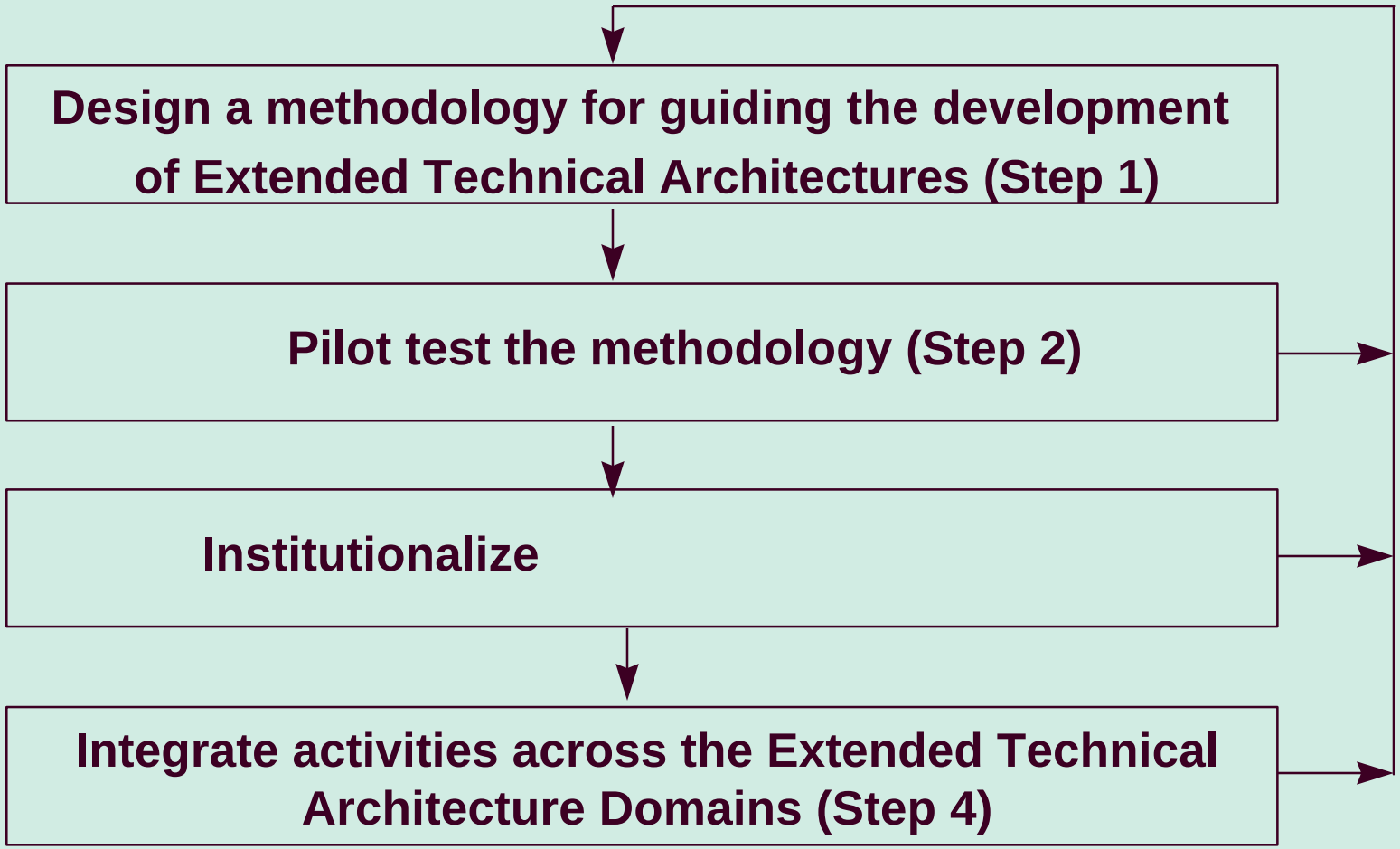
How Can the Problem be Attacked?

- Use the Open Systems Approach to:
  - Reduce the life cycle costs of weapons systems electronics through reuse of hardware/software resulting in:
    - Increased dependability: mature HW/SW with improved reliability, maintainability and availability
    - Increased deployability: mature equipment with fewer support needs
  - Support quicker insertion of new technology across weapons systems
  - Improve the interoperation of weapons and C4I systems

RAND's Idea for Addressing the Problem

- The technical architecture approach developed by the C4I community might be extended to weapons systems electronics
- We may be able to formulate a practical method for guiding the development of Extended Technical Architectures (ETAs) for weapons systems electronics

Strategy for Improving Interoperability Aims To Evolve a Methodology



The Hypothesized Role of an Extended Technical Architecture (ETA) for Weapons Systems Electronics

- Divide DoD's weapons systems electronics into domains and subdomains

- For each weapons systems electronics domain/subdomain
  - Require the services and the defense agencies to develop a set of rules for improving interoperability
  - Define the rules for a domain as the domain's/subdomain's extended technical architecture
  - Use the extended technical architectures to develop and review acquisition/modification programs at the PEO, Acq Exec, and OSD levels

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A Proposed Structure for Organizing an Extended Technical Architecture

Technical	Section 1:	Technical
		Operational Architecture
		System Architecture
		Technical Architecture
Management	Section 2:	Institutional
	Section 3:	Development, validation, and evolution
	Section 4:	Maintenance and maturation
Business	Section 5:	Resources
	Section 6:	Schedule

Technical Section of an ETA for Weapons Systems Electronics (1 of 4)

1.1 Operational architectures: answer WHAT the domain's weapons systems need to do to satisfy operators' warfighting needs

1.1.1
- Domain Operational Architecture
  - Functions to be provided by the domain's electronics, and their interdependencies

1.1.2
- Domain Software Operational Architecture
  - Functions to be provided by the domain's software, and their interdependencies

1.1.3
- Domain Hardware Operational Architecture
  - Functions to be provided by the domain's hardware, and their interdependencies

Technical Section of an ETA for Weapons Systems Electronics (2 of 4)

1.2 System Architectures: answer HOW the domain's weapons systems elements will be arranged to satisfy the OA needs

1.2.1
- Domain system architecture(s)
  - Equipment architectural style(s) for the domain: the general principles for arranging the electronics hardware and software for the domain

1.2.2
- Domain software system architecture(s)
  - Software architectural style(s) for the domain: the general principles for arranging the software

1.2.3
- Domain hardware system architecture(s)
  - Hardware architectural style(s) for the domain: the general principles for arranging the hardware

Technical Section of an ETA for Weapons Systems Electronics (3 of 4)

1.3 Interface requirements

1.3.1
- Domain interface requirements
  - Principles, practices, and standards to be adhered to in the design of system hardware and software elements compliant with the architectural style

1.3.2
- Domain software interface requirements
  - Principles, practices, and standards to be adhered to in the design of system software compliant with the architectural style

1.3.3
- Domain hardware interface requirements
  - Principles, practices, and standards to be adhered to in the design of system hardware compliant with the architectural style

Technical Section of an ETA for Weapons Systems Electronics (4 of 4)

1.4 ◆ Technical reference models defining the entities addressed by the technical architecture

1.5 ◆ Additional standards that will be adhered to within the domain

Institutional Section of an Extended Technical Architecture (1 of 2)

2.1
- Functions of institutions that are required to
  - Develop, validate, evolve, maintain, and mature the extended technical architecture
    - » Requirements for organizations and weapons systems programs to perform life-cycle management tradeoffs
      - For a weapon system
      - Across weapons systems
      - Across services
  - Apply, incentivize and enforce the extended technical architecture

2.2
- Division of responsibility and authority across institutions for providing the required functions

Institutional Section of an Extended Technical Architecture (2 of 2)

2.3

- Interface requirements for participating institutions
  - Guidelines for intra-domain coordination across organizations and programs
  - Guidelines for inter-domain coordination
    - Extended technical architectures
    - Organizations and programs
  - Guidelines for incentives and enforcement

2.4

- Current documents governing the participation of participating institutions
  - Guidance from higher authorities
  - Agreements among participating institutions

Development, Validation, and Evolution Section of a Technical Architecture

3.1 ◆ Processes

- Technical processes involved in the development, validation, and evolution of the extended technical architecture
  - » These might include tests and other methods that address the technical content of the extended technical architecture
- Milestones: approval by Services, defense agencies and OSD

3.2 ◆ Roles and duties

- OSD: funding and oversight
- Participating services and defense agencies

Maintenance and Maturation Section of an Extended Technical Architecture

4.1

- Processes
  - Activities
    - » Assessment
    - » Housekeeping and monitoring
    - » Research and refinement
  - Milestones

4.2

- Roles and duties
  - OSD
  - Participating services and defense agencies
  - Commercial R&D, standards, etc.

Resource Section of an Extended Technical Architecture

5.1

- Requirements on the nature and extent of life-cycle management tradeoffs for a weapon system
  - Across weapons systems
  - Across services

5.2

- Approach to obtaining and managing resources required for front-end investments that enable development, validation, evolution, maintenance, maturation, implementation and enforcement of technical architectures

Schedule Section of an Extended Technical Architecture

6.1 ◆ Initial establishment of the extended technical architecture

6.2 ◆ Subsequent maintenance and evolution

6.3 ◆ Resolution of schedule conflicts

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Pilot Test 1: Army Aviation

- Goals
  - Improve Interoperability
  - Reduce costs across Army helicopter systems through common use of hardware/software to be implemented during upgrades
  - Promote faster insertion of new technology
- Approach: develop an open systems architecture for accomplishing upgrades
- Status:
  - Began working with Army Aviation in February, 1998
  - Initial focus is on common mapping subsystem
  - Will be working as part of Army Aviation team in helping them with methodological approach

Pilot Test 2: Integrated Diagnostics

- Goals
  - Improve diagnostic performance to:
    - » Support availability of increasingly more complex systems
    - » Reduce life cycle costs
  - Promote faster insertion of diagnostic technology
- Approach: develop an Open Systems Architecture for standardizing diagnostic architectures, methods, and equipment
- Status:
  - Began working with DoD Executive Agent for Automatic Test Equipment (NAWC) in August, 1997
  - Initial focus was on case studies to profit from lessons learned
  - Current focus on RAND Workshop on Diagnostics, May 4-7, Santa Monica

RAND Workshop on Diagnostics
May 4-7, Santa Monica

- Workshop objective: to develop an Open Systems Architecture and standards for excellence in Integrated Diagnostics for large scale complex products
- Workshop Steps
  1. Diagnostic functions
     - Identify diagnostic functions
     - Divide functions into functional areas
     - Identify interfaces between the functional areas

     Results in defining an Open Systems Architecture for Diagnostics
  2. Evaluate current systems for shortfalls with respect to the Open Systems Architecture for Diagnostics
  3. Identify opportunities for dealing with the identified shortfalls
  4. Organize opportunities into a framework for addressing improvements
- Next step: package the Workshop products in the form of an ETA for Integrated Diagnostics

Interesting Observations

- An ARINC-like facilitation process is essential to facilitating the development and maintenance of an Extended Technical Architecture for a weapons systems domain
- A domain advocate is critical to fostering the development of a weapons systems domain
- For a domain ETA to add real value, the acquisition programs within the domain needs to develop and own the ETA
  - Basis for developing common domain solutions is economic feasibility
  - Mandates should appear in the Operational Architecture (in being clear about what has to be done) not in use of technical standards
- A methodology that addresses the three parts of an ETA (technical, management and business) is essential to the effective management of a weapons systems domain

Project Documents

"A Strategy for Improving Interoperability of Weapon System Electronics, Volume 1: Executive Summary", Iris Kameny, Jean Gebman, and Douglas McIver, DRR-1579/1-OSD, February, 1997.

"A Strategy for Improving Interoperability of Weapon System Electronics, Volume 2: Strategy", Iris Kameny, Jean Gebman, and Douglas McIver, DRR-1579/2-OSD, February, 1997.

"Fostering Collaborations Across Industry and Acquisition Programs", Jean Gebman, Iris Kameny, and Douglas McIver, PM-775-OSD, January, 1998.